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GUIDELINES
FOR
PROJECT PLANNING

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PREFACE

The "Guidelines for Project Planning" Handbook provides broad guidelines for National Aeronautics and Space Administration management personnel to plan major research and development projects. These guidelines address project management concerns identified during various Agency studies. The Handbook supplements the basic Agency policy and processes for project planning and approval set forth in "Space Flight Program and Project Management" (NMI 7120.3) in four respects:

- Delineates the roles and responsibilities between National Aeronautics and Space Administration Headquarters and Field Installation personnel.
- Addresses certain important recurring features in the project planning process.
- Designates practical applications for the recommendations resulting from Agency sponsored management studies.
- Elaborates on some of the key steps in the project planning process.

Headquarters Program Office and Field Installation managers may find it desirable to issue companion documents providing consistent, yet more detailed guidance for project planning activities under their cognizance.

Associate Administrator for Management
National Aeronautics and Space Administration

GUIDELINES FOR PROJECT PLANNING

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ILLUSTRATIONS

ACRONYMS

AA	Associate Administrator
AO	Announcement of Opportunity
APA	Allowance for Program Adjustment
C of F	Construction of Facilities
FID	Field Installation Director
F&OC	Full and Open Competition
FRR	Flight Readiness Review
GMSR	General Management Status Review
IOP	Institutional Operating Plan
MIS	Management Information System
MOU	Memorandum of Understanding
NASA	National Aeronautics and Space Administration
OMB	Office of Management and Budget
PAA	Program Associate Administrator
PAD	Project Approval Document
PIA	Project Initiation Agreement
POP	Program Operating Plan
PSA	Project Study Agreement
R&D	Research and Development
R&PM	Research and Program Management
RFP	Request for Proposal
RTOP	Research and Technology Objective and Plan
SFCDC	Space Flight, Control, and Data Communications
SRM&QA	Safety, Reliability, Maintainability, and Quality Assurance
STS	Space Transportation System
UPN	Unique Project Number

CHAPTER 1

PROGRAM AND MANAGEMENT CONSIDERATIONS

1.1 PRINCIPLES OF PROJECT MANAGEMENT

The National Aeronautics and Space Administration (NASA) welcomes and accepts the high challenge of carrying out technically advanced programs in a safe, expeditious, and cost-effective manner. The life of each individual project extends from the earliest possible date during the Definition Phase until all relevant activities are completed, including the provision of data in a final, useful form.

While high risk is inherent in the work planned and performed by NASA, every effort is made to understand and quantify this risk before seeking commitment to a project from the Office of Management and Budget (OMB) or the Congress. Comprehensive studies and cost analyses are necessary to identify and eliminate any risk factors so as to minimize the potential for operational malfunctions, cost overruns, or schedule slips. These efforts progress independently without any interference from project approval or project implementation desires.

1.2 PROGRAM CHARACTERISTICS

A program is a related series of project undertakings funded primarily from NASA Research and Development (R&D) appropriations. Each program is designed to pursue a broad scientific or technical goal, usually over an extended period of time. NASA currently supports four types of programs: Technology, Space Science, Space Flight, and Operational.

1.2.1 Technology Programs

Technology Programs are ground-based efforts characterized by:

- Research/advanced technology with a relatively low and level-of-effort funding.
- Common occurence changes in program directions in response to unexpected results.
- Unrestrained definitions of schedules for program accomplishments.

The R&D is performed by the NASA Field Installations, private industry, and universities. The out-of-house effort is an adjunct to the in-house activity and is, therefore, managed by NASA Field Installations.

1.2.2 Space Science Programs

Space Science Programs are ground-based efforts characterized by:

- Research/advanced technology in the space sciences.
- Relatively low and level-of-effort funding.
- Changes in program directions in response to unexpected results.
- Unrestrained definitions of schedules for program accomplishments.

Space Science Programs are national in scope with the R&D performed at universities, NASA Field Installations, and other laboratories. These programs do not include Space Flight Programs or Technology Programs (such as materials processing). The management of Space Science Programs is focused at NASA Headquarters.

1.2.3 Space Flight Programs

Space Flight Programs are characterized by:

- Design, development, and operations of a spacecraft, launch vehicles, and/or science and technology instruments.
- Relatively high funding levels.
- Firm schedules.
- Firm technical and scientific objectives.

Space Flight Programs often involve more than one NASA Field Installation with each providing different portions of the project requirements in conformance with an overall schedule. They frequently require close interfaces between several Headquarters Program Offices. Individual projects are planned to be an integral

part of a program (such as the exploration of the planets) and usually receive high external visibility during formulation, advocacy, and implementation.

1.2.4 Operational Programs

Operational Programs are characterized by:

- Ongoing multiple missions.
- User and/or customer requirements playing a dominant role.

Operational Programs are primarily directed to the user, with the Headquarters Program Office performing direct interface and marketing functions. For Operational Programs involving several Field Installations, a lead installation is named for key activities with the Headquarters Program Office performing an oversight function for conflict resolution and budget adjustments. Extensions and replacements of operational system capabilities are coordinated with appropriate system development organizations within NASA to strategize for acquisition.

1.3 PROGRAM MANAGEMENT ROLES AND RESPONSIBILITIES

The successful execution of programs and projects within NASA requires a formal management relationship between the various Agency organizational levels in order to maintain the necessary discipline in schedule, technical capability, and resources. The NASA Administrator, the Program Associate Administrators (PAAs), their staffs, and the NASA Field Installation personnel have significant roles in the planning, budget decisions, advocacy, and implementation of NASA programs and projects.

1.3.1 Single Center Project Management

The line of management responsibility, authority, and accountability for approved programs is from the Administrator to the PAA to the Field Installation Director (FID). The PAA represents the Administrator as a manager to ensure successful accomplishment within agreed-upon constraints. Each PAA develops a management relationship with the FIDs to permit the exercise of this responsibility and, at the same time, preserve the need of each FID for local independence and day-to-day flexibility in program/project management. This may include delegation of a portion of the PAA's authority to a Headquarters Program Director/Manager through the Division Director. The FID delegates implementation authority to the Field Installation Program/Project Manager through the Director of Projects or another appropriate authority. While program ac-

countability continues to rest with the PAA and the FID, day-to-day communications and coordination for program/project implementation are normally between the Headquarters Program Director/Manager and the Field Installation Program/Project Manager.

1.3.2 Multifield Installation Project Management

The line of management responsibility, authority, and accountability for an approved program at multiple Program Office and Field Installations is from the Administrator to the PAA, to the PAA providing institutional support, to the respective FID reporting to the PAA. The PAA represents the Administrator in managing the program to ensure successful accomplishment within agreed upon constraints. Each PAA develops a management relationship with the supporting PAAs for that program or project to ensure oversight of all segments of the program. The PAAs develop a management relationship with the respective FID to permit the exercise of this responsibility, and at the same time, preserve the need of the FID for local management authority and day-to-day flexibility in program/project management.

1.3.3 Program Formulation

The primary responsibility for program formulation lies in NASA Headquarters. The initial concept for a given mission typically originates at the grassroots level within a Field Installation. The Headquarters Program Offices have the responsibility for establishing individual missions, including technical and scientific objectives, payload selection, timing, marketing strategy, Field Installation assignments, cost parameters, and advocacy. The management of supporting research and technology and of studies in direct support of mission planning is the responsibility of the Program Office. However, conduct of the technical activity is the responsibility of the Field Installation and the details are managed by them. Field Installation personnel are responsible for supporting this effort and are specifically responsible for providing technical, cost, and schedule inputs to the Program Manager. Field Installations are also responsible for supporting program advocacy.

1.3.4 Program Implementation

Once a program/project is approved and funded, the principal responsibility for implementation shifts to the Field Installation. The Field Installations have full authority for management of the project within the agreed upon boundaries of objectives, schedules, and budget. The Headquarters responsibilities include: general management and oversight; continuous advocacy; provision of information to higher levels of NASA management, OMB, and the Congress; and coordination with other government agencies at the policy level.

The Administrator holds the PAA accountable for satisfactory implementation and the PAAs, in turn, hold the FIDs accountable for satisfactory implementation.

1.3.5 Specific Responsibilities of Program/Project Principals

1.3.5.1 Administrator—The Administrator is responsible for long range Agency goals and objectives, review and approval of new start proposals, and oversight of the overall NASA program.

1.3.5.2 Program Associate Administrator—The PAA deals directly with the Administrator on all matters pertaining to program initiation and continuing management. In some cases, the PAA holds additional roles in terms of institutional management and supporting functions. Within a program management capacity, the PAA's primary functions are to:

- Direct the formulation of new program starts as candidates (including program options) and consult with FIDs on program formulation decisions.
- Develop the Program Agreement and work with the Administrator in selecting and establishing new program starts.
- Select the members of advocate and nonadvocate teams to perform the Definition Reviews and New Start Presentation.
- Ensure that Announcements of Opportunity (AOs), when appropriate, are issued in time for the instrument selection to have a meaningful impact on project definition.
- Assign the project to a Field Installation.
- Sign the Project Study Agreement (PSA) and Project Initiation Agreement (PIA) with the involved FIDs.
- Develop an appropriate relationship with the FID and establish any delegation of PAA authority to a Headquarters Program Director/Manager.
- Approve and sign the Project Plan.
- Ensure that agreed upon project funding is secured for the Field Installation and control the Allowance for Program Adjustment (APA).

- Negotiate and sign the Project Approval Document (PAD) to agree with the Administrator on significant mission parameters.

- Provide oversight of program/project implementation.

- Serve as liaison with the Administrator during the life of a program to provide current program status.

- Participate in selected project reviews.

- Assess the project execution performance of the Field Installation, Project Office, and contractors.

Within a nonprogrammatic capacity, the PAA holds institutional responsibilities such as the following:

- Assess the roles and missions of the Field Installation to determine the availability of institutional resources to support a new project.

- Ensure that project performance is appropriately reflected in the Field Installation performance review and the FID's performance appraisal.

- Ensure the adequate support for a project once its assignment to a Field Installation has taken place.

When a Field Installation under the direction of a particular PAA is assigned projects not under the authority of that PAA, that PAA takes a supporting role. The PAA concurs in the assignment of the project to the Field Installation and ensures that the project is adequately supported.

1.3.5.3 Program Director/Manager—The Program Director/Manager is the senior NASA focal point for all NASA Headquarters activity bearing directly upon those projects and other activities comprising the program. The Program Director/Manager is responsible for program formulation to develop and administer the Headquarters guidelines and controls under which those projects comprising the program are implemented. The full extent of the Program Director/Manager's authority varies from program to program, but normally includes:

- Developing and establishing initial program objectives and long range policy guidelines.

- Managing the review of resources, including recommending and managing the program budget and the APA.

- Initiating the Definition Reviews and New Start Presentation and ensuring that appropriate recommendations are implemented.

- Recommending approval of the PSA, PIA, and the Project Plan, with associated changes to these documents.

- Establishing controlled milestones and reviewing performance to ensure their accomplishment.

- Establishing and maintaining a close and effective working relationship with the Project Manager.

- Performing interproject coordination with other Headquarters elements, and serving as the NASA representative for the program with other government and nongovernment entities.

- Keeping the PAA apprised of program status and preparing status reports and other documents required by the PAA.

In essense, the Program Director/Manager is the external liaison for a project: working problems at NASA Headquarters; preparing testimony and justification for Presidential and Congressional authorization; working with other government and nongovernment organizations interested in or participating in the project; monitoring project execution; relating the project to NASA as a whole; and controlling significant variations from the approved Project Plan. When the activities of a Headquarters support or function office affect a program or project, the manager of that program or project must be consulted.

1.3.5.4 Field Installation Director—The FID is accountable for project implementation. The FID is responsible for all matters related to the allocation of Field Installation resources. For projects assigned, the FID's responsibilites include:

- Committing Installation resources to a project by negotiating and signing the PSA, PIA, and Project Plan.

- Providing Installation resources required for project implementation consistent with the Project Plan.

- Providing overall direction of project implementation and providing accurate assessment to NASA management in a timely manner.

- Adjusting the allocation of Installation resources to individual projects as necessary.

- Performing continuous assessment of the Project Manager's performance and taking necessary personnel actions.

- Approving interinstallation agreements with concurrence of the cognizant PAAs.

1.3.5.5 Project Manager—The Project Manager is the senior official at the NASA Field Installation exclusively responsible for the implementation of a project within guidelines and controls prescribed by NASA Headquarters and Installation management. The Project Manager is the focal point for all Installation activity bearing directly on a project. Within the authority delegated by the FID, the Project Manager is responsible for:

- Supporting the Headquarters Program Office in program activity, including the establishment and maintenance of a close and effective working relationship with the Headquarters Program Manager.

- Planning, evaluating, and directing the execution of the project.

- Preparing, agreeing to, and maintaining the PIA and Project Plan.

- Integrating systems and project-wide system engineering services obtained from other groups within the Field Installation.

- Estimating and justifying requirements, managing resources (including contingencies), and directing project business.

- Monitoring and understanding project progress and performance, including contractor progress and performance in technical, cost, and schedule areas.

- Reporting project status, problems, and assessments to Installation management and to the Program Manager.

CHAPTER 2

PROGRAM AND PROJECT MANAGEMENT OVERVIEW

2.1 PROJECT PLANNING SCOPE

Project planning concerns the development of projects in an orderly and efficient manner. A phased approach to project development provides a process for continual assessment of the technological, managerial, and resource uncertainties prior to final Agency commitment. This approach permits management reviews of planning and implementation activities.

Effective project planning is vitally important for NASA to perform at a level of excellence. Regardless of planning precision, risks and uncertainties cannot be totally eliminated in projects of a technically advanced nature. If the planning is done well, then important national and Agency objectives can be met safely with wise expenditures of resources. If not done well, then waste, delay, failure to meet objectives, damage to the entire forward momentum of the program, and loss of confidence in the Agency can occur.

2.1.1 Definition of Agency Policy

Agency policy states that the project planning process applies to new, major R&D projects and to significant extensions of existing major projects. They are to be undertaken only on the basis of plans and analyses that define clearly the work to be done, provide assurance that the required technology can be made available, and set forth realistic resource and schedule estimates. Those projects that qualify as major research and development projects normally have two or more of the following characteristics:

- Encompass design, development, fabrication, test, and operations of advanced aeronautical and space hardware.
- Require significant Agency resources in terms of manpower, funding, and facilities.
- Involve important relationships with external organizations, the public, or foreign governments.

2.1.2 Characteristics

Since major NASA projects are characterized by their individuality, project planning must recognize and account for the particular needs of each project. This can be done by using a project planning approach that is:

- Systematic, in providing an orderly and progressive buildup of knowledge covering all aspects of a project. At a predetermined point, management has sufficient information and confidence to support a decision on project implementation.

- Flexible, in accommodating the particular characteristics of each project. The Project Manager has the responsibility to tailor a plan to fit the project rather than a requirement to adapt the project to a preconceived plan.

- Disciplined, in providing effective means for in-depth management review, approval, and control of new project starts and projects under development and execution. This includes specific control levels and designated milestones for the Project Manager to present a comprehensive review to management on the status of the project.

- Multifunctional, in bringing together all relevant professional skills, including managerial, scientific, technological, legal, and procurement. These skills are unified by the Project Manager in appropriate and timely combinations, commencing early in the planning effort.

2.2 IMPORTANCE OF EFFECTIVE MANAGERS AND TEAMS

"Good people are the key to good project management. Sound project planning, management practices, and source selection approaches are all important. However, they cannot substitute for having high quality and highly motivated people responsible for project management—both inside and outside of government." (NASA Project Management Study, Don Hearth Chairman; January 1981).

2.2.1 Team Functions

All the qualities needed for project management are rarely (if ever) to be found in a single individual. Therefore, emphasis is on building a project team within which the key members play complementary roles with respect to the presence and strength of personal skills, experience, and characteristics and accept shared responsibility for project success. The Project Manager must have the ability to work effectively with a wide variety of people in order to build a cohesive and well integrated project team.

In the broadest sense, the project team includes all of the individuals in the Field Installation and in NASA, and those contractors working directly on the project. In the more limited sense, the project team refers to the staff of the Project Office and other members of the Field Installation responsible to the Project Manager for particular tasks or functions.

Even though the Project Manager's job involves a major technical undertaking, the interpersonal, managerial and conceptual skills are relatively more important. Technical skills are available in abundance on a team. Team management and leadership skills that are required of the Project Manager include:

- Selecting the team members.
- Providing clear goals and parameters.
- Clarifying authority and responsibility.
- Keeping team members fully informed.
- Involving appropriate personnel in problem solving.
- Mediating differences.
- Integrating and coordinating efforts.
- Encouraging initiative and exchange of ideas.
- Creating an atmosphere of trust.
- Generating enthusiasm and team spirit.
- Bestowing recognition and rewards.
- Winning respect of the team members.

2.2.2 Decision Making

Projects are such a system of interacting elements resulting in a dispersion of responsibility, that Project Managers are more likely to make decisions in concert with others rather than in isolation. Nearly every decision is the result of successive reviews and negotiations with systems managers, experimenters, functional managers, and Headquarters representatives. This shared authority offers the advantage of broader participation to cover technical and other problems in greater depth. It also encourages a sense of responsibility in the participants to work for the common goal and to refrain from aggrandizing their own interests. Ideally, the sharing of authority helps to maximize innovation while minimizing error. The competitive atmosphere of integrating the often conflicting requirements of various systems creates tension, but it also keeps the participants conscientious. The participants must put forward their best arguments and reasoning abilities in support of their requirements. Negotiations and compromise are important elements in the system. Success depends upon mutual cooperation, which is produced by the strong support of technical argument and the consideration of alternatives.

One could say that Project Managers are paid not to make the decisions but to ensure that the proper decisions are made.

2.2.3 Problem Solving

Project Managers must overcome the temptation to deal with technical problems in too great a depth. The Project Manager should effectively delegate responsibility and accept the role of manager rather than technician. The Project Manager can develop a closeiy knit project team by decentralizing problem solving, with emphasis on technical problem solving at the level where both the problem and the most experience reside. He is expected to enter into the problem solving process only to resolve serious conflicts impacting related components, subsystems, schedule, or cost. Project team members are encouraged to feel a sense of responsibility for problem solving at their respective levels, within the assigned guidelines of performance, resources, and time.

2.2.4 Summary

"No one Project Manager can claim all the virtues usually listed as necessary to have a project succeed. For the most part, the Project Managers led teams whose members were highly committed to the project and who derived great satisfaction from selflessly contributing to the team's purpose. The project was the focus—organizational lines and personal ambitions were submerged in the common effort required by contractors, Headquarters and Installation officials, university experimenters, and project staff. This was the driving force of NASA's success." (Project Management in NASA: The System & The Men, Chapman et al.; 1973).

2.3 ORGANIZATION INTERRELATIONSHIPS

The accomplishment of programs and projects by NASA requires the interaction of managerial, research, and development organizations at NASA Headquarters and Field Installations. In the larger programs, individual projects may be managed at more than one Field Installation and implementation responsibilities may be assigned to more than one PAA. Therefore, it is important that organizational roles, responsibilities, and accountabilities be understood by all program participants. One method used in the clarification of organizational interactions is called the "B Plan Process."

The B Plan Process is a systematic, structured approach to defining, building, and restructuring an organization and clarifying communication. The Process provides management with a means of defining roles and relationships. As a planning method, it serves to clarify ambiguous roles and defines participation levels for specific functions to be accomplished. It also provides management with a tool to identify and resolve conflict. The B Plan Process maps how the job—at any level—gets done.

As a problem solving tool, the B Plan Process employs a unique combination of systems engineering and people-oriented concepts to identify and resolve organizational problems. The Process is flexible enough to accommodate varying managerial styles and is equally workable in a large, complex, rapidly changing environment or a small, stable, functional organization. It is a problem-solving system that bridges the gap between staff and line, formal and informal, product/program and functional, and hierarchical and task structures or organizations. It can be used at any level of management in any organizational structure, whether industrial, government, or voluntary—wherever people work together to get a job done.

The objectives are to identify, surface, and solve problems (either internal or external to an organization) that may relate to ill-defined concepts or policies, ambiguous roles and relationships, fuzzy accountabilities, inadequate or poor communications, ineffective management controls or procedures, and interpersonal work conflicts. It is a process that is viable enough to enable members of work groups to systematically identify and resolve their accountability interface differences within the context of the job to be done and in a constantly changing environment.

As an evaluation tool, the B Plan Process may be employed for studying current organizational procedures, for the development of productive work team interfaces, or for the modification of organizational relationships.

2.3.1 Roles, Relationships, Meanings, and Codes

Roles and relationships are described in terms of the kinds of responsibilities held by each member of the authority structure. NASA utilizes seven kinds of responsibilities in day-to-day operations. There are others that have not found a place in NASA at this time. The responsibilities and codes that are used to represent them are:

H—Assuring responsibility: assure that a task is assigned or delegated and accomplished; that the assignment/delegation continues to make sense in the light of changes to priorities, resources, or objectives.

B—Basic responsibility: hold accountable that the task is performed; the buck stops here.

C—Partial responsibility: delegate some portion of the basic responsibility.

E—Consult before task is completed.

F—Approve/disapprove before decision is completed.

G—Must notify of the task completion.

H—May consult before task completion.

AND

D—Basic responsibility for a project WITHIN the boundaries of the B responsibility AND having a completion date.

I—Concurs/does not concur: agrees, assents without taking part in the action; implies recognition that an action is completed and has good reason to be completed.

2.3.2 Tasks to be Accomplished

The mapping of an organization requires that at least three ingredients, each dependent upon the other, be present:

1. The job that is to be accomplished must be delineated and defined in an objective and systematic manner, taking into account the goals of the organization, its structure, and its problems.

2. Within the framework of the defined job, the people necessary for accomplishment must be identified and relationships with the task and others must be delineated.

3. After roles and relationships have been defined, clarification of the relationships between task, employees, and managers takes place. This includes:
   a. Integration of individual effort
   b. Resolution of conflicts
   c. Enhancement of communication
   d. Involvement of other work groups affected.

A mechanism to maintain visibility and communication and to facilitate timely review and recycling of the process should be established. The responsible organizations and the degrees of accountability can be mapped on the matrix shown on the following page.

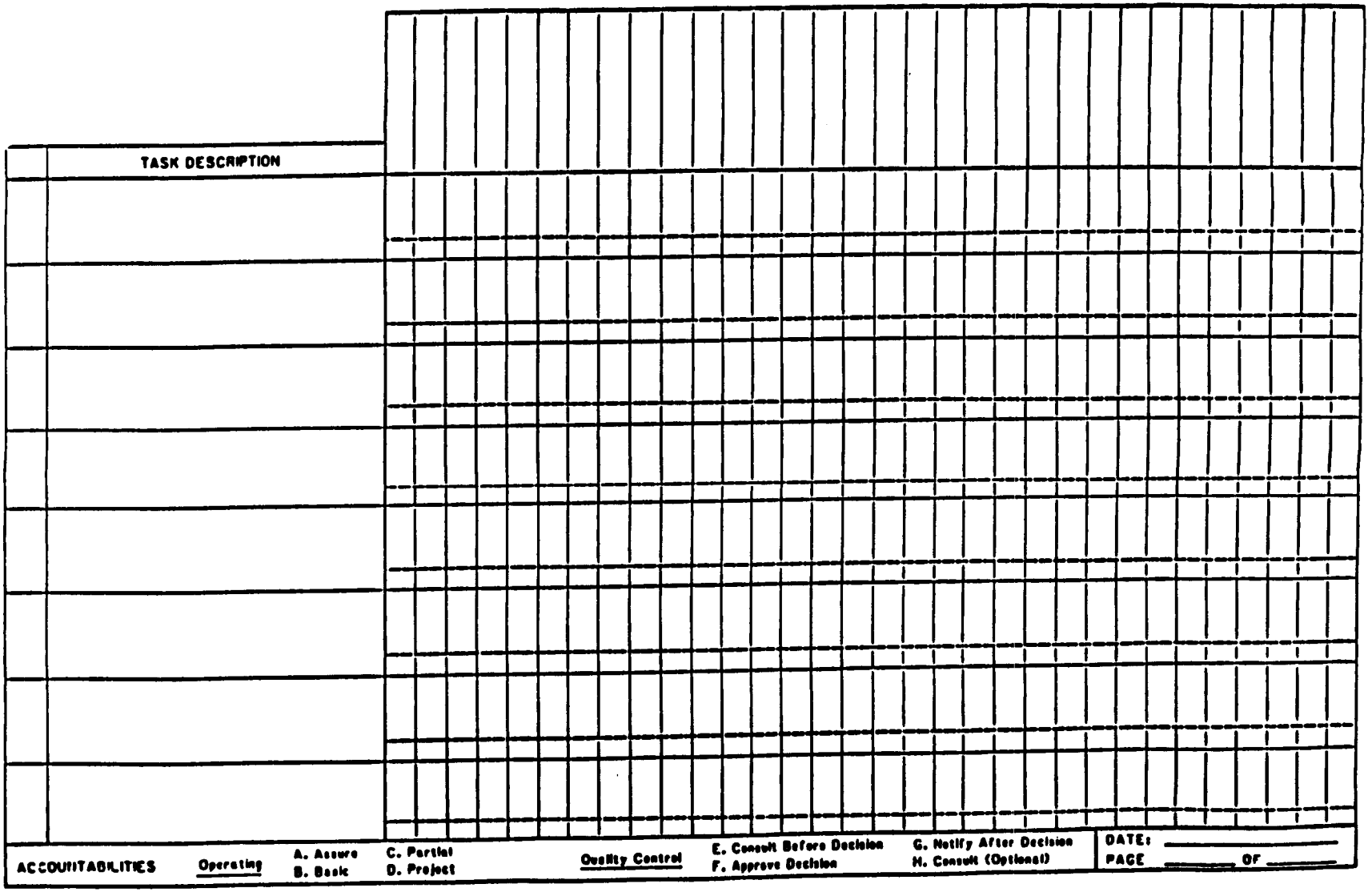


Figure 2-1. B Plan Process Matrix

2.4 TECHNOLOGY ASSESSMENT AND TIMING

Extensions of technology commonly are required for the kinds of projects usually pursued by NASA. In many cases, these ventures involve breaking entirely new ground.

When new technology is pursued, uncertainties usually exist. More time may be required for the technology to be developed. The technology itself may evolve in unanticipated directions and may even fail to emerge in an acceptable form. The software required may have evolved significantly since initial definition and may require a more lengthy developmental timeframe. Any happenings of this sort can profoundly affect the welfare of the project. This is of prime concern to the Project Manager and to all levels of Agency management.

The technology development plan should be built into the overall plan for the project, consistent with project requirements. It should contain a realistic schedule for the attainment of technological milestones. There may be some areas in which the state of technology may require more than one technological approach to be studied, even to the point of early development funding. The technology plan should reflect these requirements.

Management may choose to include various technological milestones in the control limits while approving the plans for the project, thus triggering automatic review and reconsideration of the project in the event the milestone objectives are not met. In any case, project management must monitor technological progress and give early warnings of threatened shortfall or delay so that consequences and responses can be considered at appropriate management levels in a timely and efficient manner.

2.5 SYSTEMS ASSURANCE

Systems assurance activities include safety, reliability, maintainability, and quality assurance (SRM&QA) factors that ensure the operational success of all NASA activities and programs. SRM&QA, technical issues, and lessons learned must be fully considered during design reviews, flight readiness reviews, test readiness reviews, operational readiness reviews, or equivalent formal reviews. These reviews are conducted prior to the start up of operations for ground facilities, manned launches, unmanned launches; aircraft flight programs; and acceptance testing of experimental facilities and hardware, which have significant risk to persons or property. The systems assurance effort includes the monitoring of the status of equipment and software, design validation, problem analysis, and system acceptability. This organized systematic approach identifies and controls hazards to ensure that safety factors are fully considered from conception to completion of all NASA activities.

The Project Manager has the full responsibility for systems assurance. The SRM&QA organization provides or supports the systems assurance activities as well as independent oversight.

The SRM&QA organization ensures that SRM&QA policies, plans, procedures, and standards are established, documented, maintained, communicated, and implemented. The organization also ensures that a fully documented trend analysis program is conducted. This includes the accurate reporting of anomalies, thorough analyzing and testing of problems, and implementing corrective measures. The SRM&QA organization serves as the independent agent at all formal reviews. Other SRM&QA activities include:

- Independent review of SRM&QA practices and standards as they apply to specific programs/projects.

- Application of reliability and system safety risk assessments to identify potential hazards or failure modes for all projects or operations.

- Analysis and categorization of the potential for hazards or failures.

- Ensurance that detailed operating and emergency procedures or administrative controls are developed to overcome or reduce the hazards or the effects of the failures. (This is necessary if hazards cannot be eliminated or reduced to acceptable levels by design or engineering changes).

2.6 RISK MANAGEMENT

Risk management assures that any hazards within a project are identified and evaluated in a timely manner; the risks are assessed and deemed acceptable and consistent with the complexity of the system; and the aggregate risk is recognized and accepted by project management.

2.6.1 Risk Identification

Hazards associated with each project are identified, documented, and reviewed periodically to assure risk visibility.

2.6.2 Risk Assessment

Risk assessment is a continuing process throughout the life cycle of a project, but formal risk acceptance must be performed prior to initial system operation and all significant project activities. Decisions regarding

resolution of an identified hazard are based on assessment of the risk involved. Hazards are characterized as to severity and probability. Since the goal of NASA is to eliminate hazards by design techniques, a risk assessment procedure considering only the severity issue generally suffices during the early design phase. When hazards are not eliminated during the early design phase, a risk assessment procedure based on the probability and severity is used to establish priorities for corrective action and resolution. Quantitative analysis is performed only where (1) the risks of parts-components failures and human errors for the operational environment are known with reasonable confidence and (2) the criticality of alternative designs is sufficiently important to safety. The risks are presented to the appropriate level of management for approval after all risk avoidance measures have been identified and studied, and after the technical rationale for risk acceptance has been documented.

2.6.3 Risk Reduction

Risk reduction criteria provide a consistent and systematic method for assuring that the risks associated with identified hazards are minimized. Risk closure criteria are established to assure that risks are evaluated and closed uniformly. Hazardous conditions, causes, effects, control (or acceptable rationale), verification, results, and status are identified and documented as a product of the hazard analyses. It is the Project Manager's responsibility to evaluate these analyses to assure that the requirements are being met and that risks associated with the hazards are reduced to the maximum practical extent. As the design progresses, actions for reducing the risks are undertaken in the following order of precedence:

1. Design to eliminate the hazard or hazardous operation.

2. Reduce risks to an acceptable level through the use of fixed, automatic, or other protective design features or devices.

3. Provide detection and warning/caution devices.

4. Develop procedures and training including protective equipment for personnel.

A lesser degree of desirability exists for each succeeding control method. If a risk reduction method other than elimination of the hazard source or hazardous operation is selected, a certain level of risk must be assumed by the Project Manager. The acceptability of hazard controls should be based on the nature of the risks and the options available to achieve the maximum benefit.

2.6.4 Approval of Risks

Each risk is evaluated, documented, and accepted by the Project Manager. Accepted risks are reviewed periodically to take advantage of new technology, concepts, and conditions that may permit hazard elimination or control. The review process and documentation requirements may vary from project to project; however, all accepted risks must be documented and approved by the appropriate NASA management level as defined in the Project Plan.

2.7 INTEGRATING USER REQUIREMENTS AND SOFTWARE

Software is a key component of the technically sophisticated and highly dependable NASA systems. The software requirements, expectations, and satisfaction levels of users are of primary importance in the success of a mission. Usability, versatility, and reliability are critical software dimensions.

Software is developed in a pattern similar to and concurrent with project development phases. The initial step is a conceptual statement of requirements from the users' point of view. From these early discussions, expectations are solidified and the probable promotion of later changes are lessened. Specific areas such as command and control of a spacecraft instrument, amount of expected data, types of data products, data analysis, and data distribution and archival are defined.

Once these areas are agreed upon by the users and mission providers, an analysis of software techniques occurs. The software analysis "freezes" the concepts and an AO is released for development activities. The software development life cycle typically includes requirements definition, design, code/debug, integration test and transfer, and operation/maintenance.

Concurrent with the various review sessions held on the project, the software undergoes reevaluation to ensure that the original user requirements are addressed and fulfilled. Mission providers and users must be careful to adhere to original definitions to reduce cost overruns due to changing expectations and requirements.

CHAPTER 3

STRUCTURING PROJECT DEVELOPMENT

While NASA projects are characterized by their individuality and require customized plans for development, some aspects of each project are generic within the Agency. Individual projects share three planning aspects: phasing of the work, integrating with the Federal budget process, and developing an acquisition strategy. To a considerable extent, the success of the project plan depends upon how these are adapted to the needs of the particular project. Judgement is paramount in all cases, as it is usually difficult to place quantitative values on the considerations involved.

3.1 PROJECT PHASING

Rather than following an elaborate, baseline project planning system that recognizes discrete phases of project work separated by formal decision points, a phasing structure that best meets the needs of each project is recommended. In the beginning, one generally deals with alternative concepts, objectives, general procedures, and so on. Then, there is a flexible period in which more specific trade-offs are made, the system is designed, the configuration is settled, most of the technology problems are solved, and the final design is constructed. Toward the end, the job becomes primarily one of developing, building, testing, operating, analyzing, and reporting. The most costly portions of the project (generally the final design, development, testing, and operations) can proceed with efficiency only if:

- Adequate definition has already taken place.
- Necessary technology has been delivered on time.
- Original software requirements have been adhered to faithfully.
- Efficient management approaches have been developed and implemented.

The identification and definition of the various tasks and their arrangement into an appropriate orderly sequence are what constitute proper planning. Agency planning practices have evolved using four discrete phases separated by various decision points:

Phase A: Preliminary Analysis
Phase B: Definition

Phase C: Design

Phase D: Development/Operations

The system of project planning set forth in these guidelines employs a tailored type of phasing that is unique to each project. The "ABCD" terminology generally has become known and remains as a cornerstone for dialogue; the phases are terms for the logical order of progression to communicate the state of development. However, within each phase and within each project, different activities and variable timeframes must be accommodated. Figure 3-1 summarizes project phasing with major activities and management responsibilities categorized.

Each phase of project development requires a deeper commitment by NASA to the project in terms of priorities and resources. Consequently, the level of approval to proceed to the next phase involves more responsible program authorities.

The documentation of goals and resources for the next phase results in a series of contracts between succeedingly higher levels of program authority. The principle elements of such commitments and controls are discussed in the following sections.

3.1.1 Conceptual Studies and Preliminary Analyses

New ideas for future projects flow from the activities of the Field Installations, user communities, and Program Offices. Ongoing programs in various disciplines examine concepts that may identify future projects. The Program Office and Field Installation personnel continually interact with the scientific and technical users to identify new initiatives. Selection and funding of these most promising concepts are the responsibility of the Division Director. Through a Program Manager, Program Scientist, and Project Study Team, a Division Director authorizes funds to document the objectives and requirements of the user community in a Phase A study (normally as part of a Research and Technology Objective and Plan (RTOP)). In some cases, an AO may be used to select the most promising scientific or technical investigators to define the mission requirements. In other cases, a Field Installation submits a mission requirements definition directly to the Program Office for consideration. Another significant output of the Phase A studies is the PSA that is approved by the PAA to continue work on those projects deemed worthy of further pursuit.

3.1.2 Adequate Depth of Definition

An appreciable amount of work always is required to examine alternative approaches to meet objectives, adjust objectives to what reasonably can be accomplished, make important trade offs as concepts harden, and converge generally toward a definition of what is to be expected. This is particularly signficiant in projects

PHASE / PROGRAM/ PROJECT RESPONSIBILITY	PHASE A	PHASE B	UNDERSTANDING PERIOD	PHASE C/D
ACTION GROUP	Headquarters Program Offices and Field Installation Study Team	Project Study Team	Field Installation Project Office	Field Installation Project Office
OBJECTIVE	Conceptual Studies	Define Project requirements	Validate baseline design and cost estimate	Accomplishing Project objectives
PROGRAMMATIC RESPONSIBILITY	Headquarters Division Director	Program Associate Administrator	FID and Project Manager	FID and Project Manager
AUTHORIZING AGREEMENT	RTOP	Project Study Agreement	Project Plan	Project Plan
BASIS FOR FINAL COST	Parametric estimates	Grass roots estimates and independent estimates	Review of Contractor and Project estimates	Annual Confirmation Review Update
OUTPUT	Mission Requirements Document and Project Study Agreement	System Performance Specification, Project Initiation Agreement, Definition Reviews, New Start Presentation	Confirmation Review and Presentation to PAA	Completion of Project objectives

Figure 3-1. Phasing of Activities and Responsibilities

aimed at producing new systems, advancing technology beyond the current state of the art. The definition should have sufficient depth so that it is acceptable as a foundation for an expanded effort in which significant and increasing resources are to be effectively consumed. If a project proceeds without adequate definition, it is exposed to a set of interrelated risks at a time when the cost of an adjustment is at its highest. The project baseline must be accomplished when the complete project and contractor teams are staffed.

Some of the most significant factors contributing to overall project cost growth occur during definition activities. Former Project Managers identify these as:

- Timing of software/hardware design trade-offs.
- Changing user requirements.
- Restrictive performance specifications.
- Ineffective organizational relationships.
- Timeliness of the acquisition plan.
- Lack of understanding by the contractor as to the extent of the work.
- Inadequate staffing.

An accumulation of these factors brings the high probability of trouble, in one form or another, including the dilution of objectives or cancellation of a project.

During the project definition effort, the transition of programmatic responsibility from the Program Office at NASA Headquarters to the implementing Field Installation begins. A Project Manager is assigned to manage the effort until completion. A Project Study Team is established to carry out the project definition tasks in cooperation with other functional organizations within the Installation and with the users. The Project Manager, the Project Study Team, and the users fulfill the technical plan and abide by the resource allocations agreed to via the PAA and FID signatures on the PSA.

The project definition normally includes further study of user requirements, software definition, functional support requirements, and the space system. In the past, these have been conducted by in-house study teams, by multiple contractors selected as a result of a competitive process, or by a single contractor after agreeing to exclusion from the Development/Operations Phase. The Project Manager must select the phasing approach that is most compatible with the project needs, resources, extent of new technology, maximum competition, and anticipated final cost. The PIA is prepared to begin documenting the detailed project planning process. As the definition work progresses, the cost limits established by the parametric modeling techniques are refined by the development of detailed cost studies, grass roots estimates, and studies by contractors not involved in the final development. All such activities tend to strengthen the project knowledge and increase the likelihood of a successful outcome. After the cost and mission parameters are adequately defined and accepted by the Field Installation, an independent review of the project is authorized by the AA. A presentation of the results is then made to the Administrator prior to the Agency recommendations for inclusion in the Federal budget.

3.1.3 Planning the Development Phase

The plan for the Development Phase completes the documentation of the Headquarters/Installation contract in the form of the Project Plan. It also completes the transition of programmatic responsibility to the Installation.

Just as in the Definition Phase, Project Managers use different approaches to the development activities. A project in which the contractor is to be given mission responsibility for all systems (space and ground), separate competitive procurements for succeeding phases may be desirable to select the most appropriate mission concept. When extensive development of new scientific and technological systems are required, the same phasing approach may produce the best design, management, and cost benefits.

However, where in-house definition studies have been extended or when a space system is a reprocurement of a previous system with only minor modifications, the best approach may be a combined Phase BCD acquisition. Furthermore, some Project Managers feel that a contractor is not motivated to disclose his best concepts or designs if such designs are to be incorporated in a succeeding competition with other contractors. In this case, the Phase B contractor is motivated to reserve his best concepts and designs so that he would have a better chance of winning the space project contract.

The selection of a phasing plan for the final hardware development must be carefully planned, giving consideration to state of development, number of partners, and the probability of continuing with the project without interruption between significant phases.

After the contractor has been selected for the final development, a period of work exists in which the project team and the contractor explore fully and openly the plans for the work. In the original design of the NASA spacecraft development process, this activity was considered the final design (Phase C) effort. As Phases C and D were combined, this understanding activity did not receive adequate attention. In a combined Phase C/D activity, therefore, it has become important to proceed at a slower pace and develop this full understanding. This can be accomplished as a part of the prime contract or by a separate phase-in contract in much the same manner as the transition to a successor contractor for large support services activities. The contractor must not disrupt the validity of the competitive procurement by any rebaselining of the estimated cost. Since the cost and fee are factors in the selection of the final prime contractor, only the estimated cost should be adjusted after the Understanding Period.

At the completion of the Understanding Period, the project shall present the results to the PAA or his designee to confirm the previous estimate of final cost or discuss any adjustments. This presentation should be in the same format as the New Start Presentation with any variances highlighted. Once each year, or at times agreed to by the Program and Project Offices, the Project Manager shall make a similar presentation. This annual Confirmation Review should be conducted in February or March as a part of the Agency program planning reviews prior to the Federal Budget preparation.

3.1.4 Planning for the Operational Phase

Support required for the Operational Phase of the project must be considered early. Firm plans should be in place prior to launch to ensure smooth transition activities. Should a new organization be required for operations, written agreements between involved parties are necessary. Technical parameters to consider for the operational phase include space and ground systems operation; data acquisition, handling, analyses, and distribution; and documentation. Administrative considerations include milestone identification, schedule, contract management, and mission reviews.

3.2 BUDGET AND ESTIMATING CONSIDERATIONS

The NASA cycle for requesting and receiving resources for Agency programs and institutional needs is multiyear, covering all segments of the Agency and culminating in a unified submission to the Congress. Figure 3-2 illustrates this multiyear cycle. Program or project cost estimates provided to Congress are based upon historical data and accurate projections of future conditions. The OMB and Congress treat the early cost estimates as firm commitments and significant cost growth is not tolerated.

3.2.1 NASA Budget Structure

NASA uses four appropriation titles in its annual budget submission to the OMB. These four accounts are Research and Development; Construction of Facilities; Research and Program Management; and Space Flight, Control, and Data Communications. The data input to these budget requests are gathered from the individual Field Installations via budget calls. Each Project Manager uses his early budget estimates of manpower, facilities, and technical costs to input data to the calls. As shown in Figure 3-3, individual budget call categories fold back into the four appropriations as follows:

- The Research and Development Budget results from the Program Operating Plan (POP) constructed from grass roots estimates at the Field Installations with a midyear update. The R&D Budget finances the purchase of materials, contractual services, R&D transportation costs, equipment, test and evaluation, and technical information support. These items are required in direct support of flight projects and basic research, and in operations of the tracking networks. Funds expire for obligation purposes at the end of the two-year appropriation period; however, NASA Headquarters Program Office and reimbursable government customers may establish earlier expiration dates for the use of these funds by the Field Installations.

- The Construction of Facilities (C of F) Budget finances the design, construction, purchase of equipment, modernization of facilities, and advance design of facilities planned for future authorizations. All construction involving new structures, wherein the costs exceed $75,000 and modifications to existing structures cost in excess of $75,000, are financed by this appropriation. C of F funds for new construction greater than $250,000 and modifications and other construction greater than $500,000 are not limited by Congressional action as the life duration. However, NASA has the option of establishing expiration dates for the use of these funds by the Field Installations. The Project Manager should be aware that the cycle from the grass roots call for authorization to receipt of construction funds could be up to five years.

- The Research and Program Management (R&PM) Budget is established as the result of the Institutional Operating Plan (IOP) generated annually by the individual Field Installations. This process provides for the personnel related costs of NASA such as civil service salaries, overtime, travel, transportation, rentals of equipment, administrative communications, utilities, printing, and other housekeeping operations not specifically associated with a direct research project. The R&PM appropriation is an annual appropriation, that is, the authority to obligate these funds automatically terminates on September 30 and any residual funds are lost to NASA.

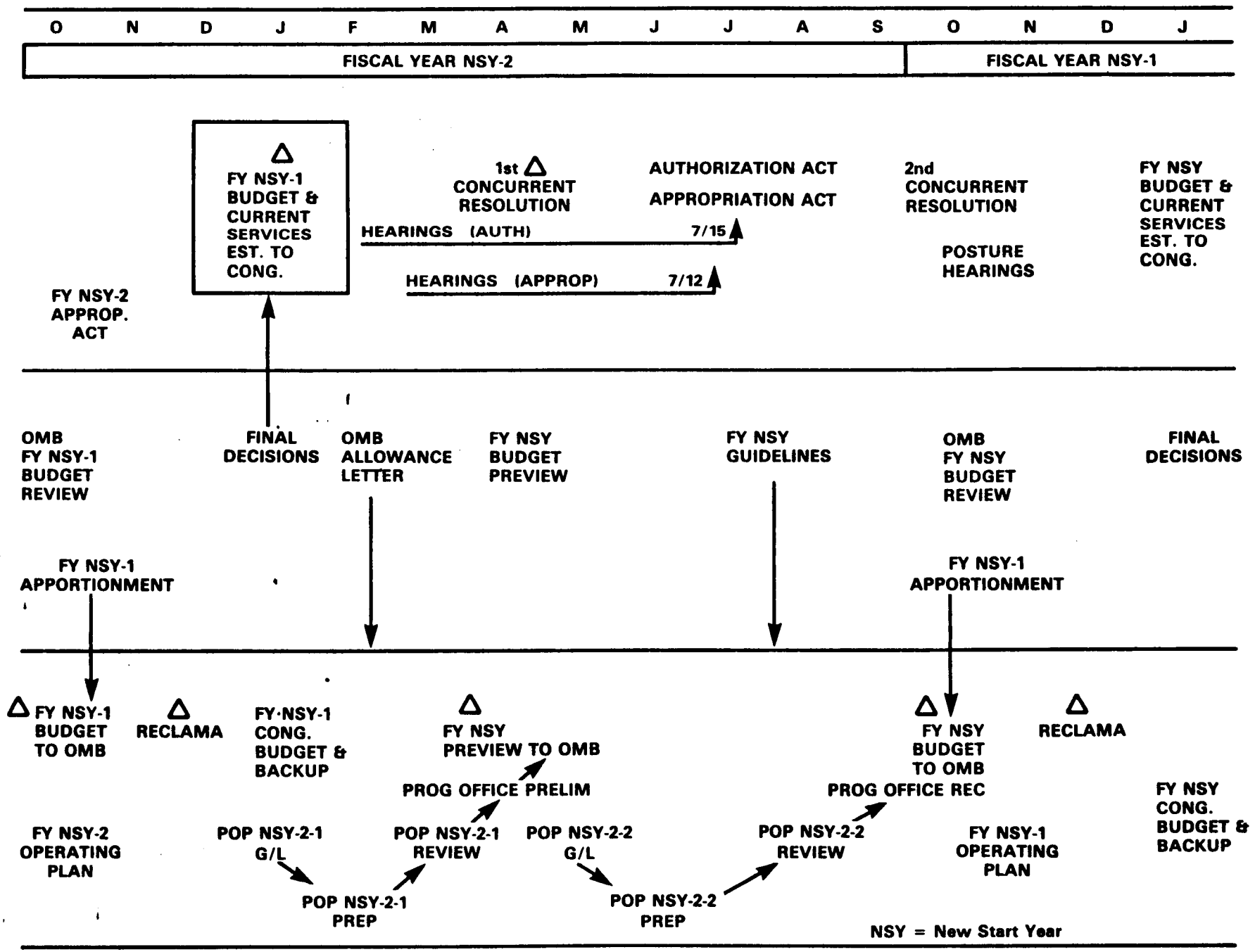
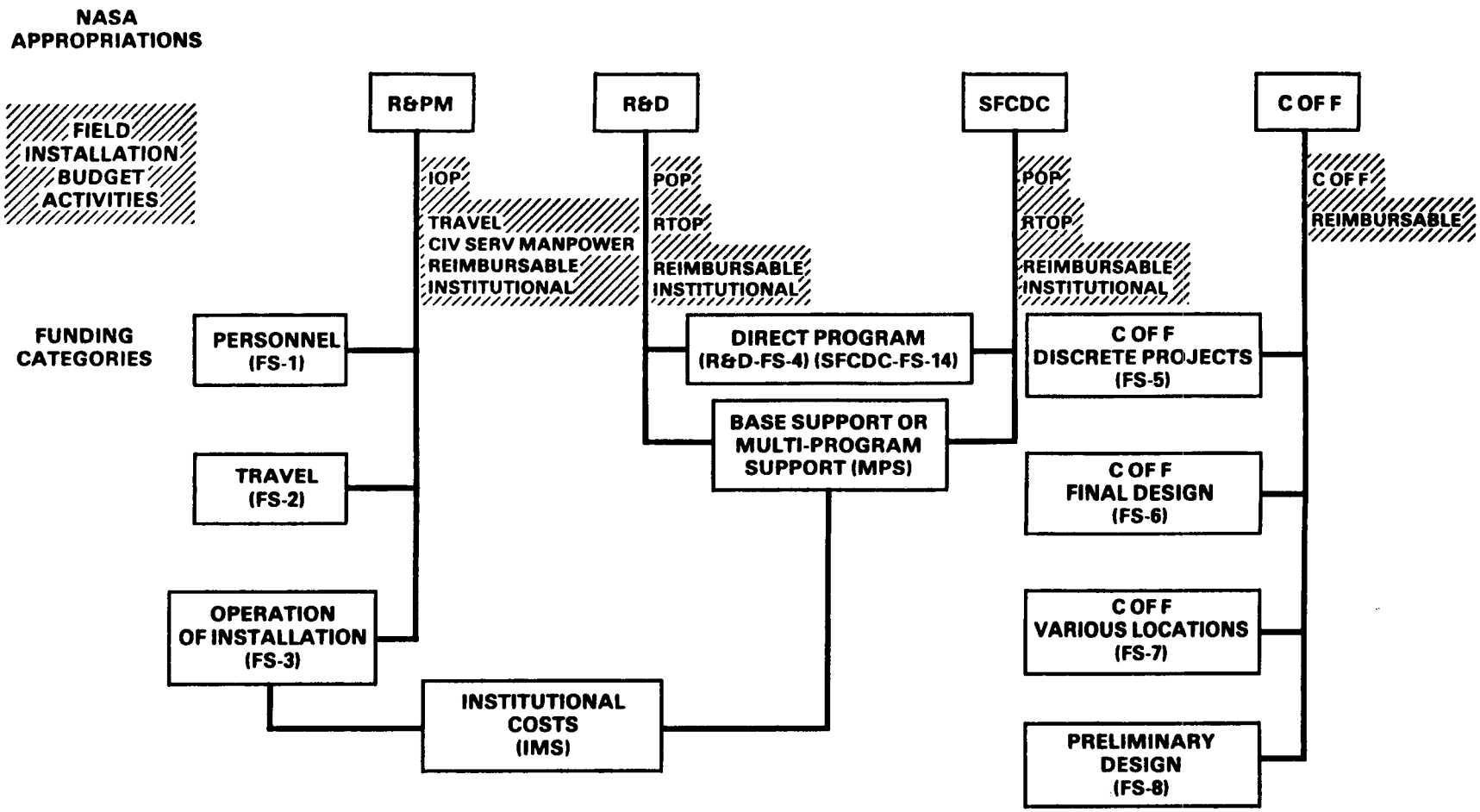


Figure 3-2. NASA Budget Cycle



C OF F - CONSTRUCTION OF FACILITIES
FS - FUND SOURCE
IMS - INSTITUTIONAL MANAGEMENT SYSTEM
IOP - INSTITUTIONAL OPERATING PLAN
POP - PROGRAM OPERATING PLAN
R&D - RESEARCH AND DEVELOPMENT
R& PM - RESEARCH AND PROGRAM MANAGEMENT

SFCDC - SPACEFLIGHT, CONTROL AND DATA COMMUNICATIONS

Figure 3-3. NASA Appropriations, Budgets, and Funding Categories

- The Space Flight, Control, and Data Communications (SFCDC) Appropriation (established July 1983) also results from the POP. The SFCDC Budget finances efforts associated with space shuttle production and capability development, space transportation operations, expendable launch vehicles, and the Tracking and Data Acquisition Program activities of Space Network, Ground Network, and Communications and Data Systems (excluding Advanced Systems). This appropriation has a two year limit on expiration for obligating the funds.

3.2.2 Estimating the Cost

For a new project, an initial "top-down" estimate of cost is based on the derived requirements needed through completion of the project. This is sometimes accomplished through the use of parametric modeling techniques. Items such as the nature of the mission, spacecraft structure and weight, subsystems, launch system, communication, acquisition strategy, facilities, risk, spares, and phasing are considered. During definition activities, a grass roots estimate is developed including components from each functional organization involved in the project.

A parametric estimate seeks to establish a relationship between measurable characteristics on space systems (such as weight, volume, power, data rates, orbital inclination, etc.) and the total recorded costs for the completed space system. The relationship is then used to project the cost of new and not totally defined space systems. This results in a model of the outside limits of the new system. NASA maintains or has access to cost modeling systems for scientific instruments, spacecraft subsystems, and aeronautical systems. The Project Manager finds these models extremely useful in developing preliminary cost estimates and establishing a confidence level in the grass roots cost estimate. The technique also aids in establishing the amount of Contingency and APA funds to set aside for counteracting various areas of risk.

Two significant factors are built into the budget planning process to allow for some flexibility and controlled growth. Contingency reserves are funds allocated for the resolution of potential problems in assuring compliance to the specified project scope. These reserves are under the control of the Project Manager to use as needed. He is responsible for reporting the status and use of these resources. APA funds are provided by Headquarters for the resolution of unforeseen major problems, expansions in mission requirements resulting from changes in project objectives or scope, project schedule "stretch outs", and so on. These reserves are under the control of the Headquarters Program Office.

Once the estimate is determined, an independent committee within the Agency evaluates the estimate for the project. The Project Manager should then integrate the phasing of the project and the estimate with the budget cycle. This plan should include a period of hiatus during which the project continues definition ac-

tivities while awaiting Congressional approval of the development budget. Once approved, the project and the selected contractor move into a period of understanding to confirm the estimate and the Agency commitment to Congress on the requirements for resources.

3.2.3 Unrealistic Cost Estimates

A project lacking appropriate depth and uniformity of coverage in the early phase of study is almost surely lacking a credible estimate run-out cost. Attention must be paid to all of the primary project elements in the early phase, thus avoiding a situation in which some aspects are understudied relative to the others. A level of depth in the early studies must be sufficient to guard against a gross miscalculation in cost estimation. Some causes of inaccuracies in cost estimations that have been identified in previous projects are:

- Requirements are not well understood.

- Inadequate definition prior to the NASA decision to proceed with project implementation and the Agency's commitment to the OMB and the Congress, including:

  — Limited advanced technology development and inadequate definition of the technical, cost, and schedule requirements for the project to be implemented.

  — Over optimism, in terms of the cost and schedule requirements for new projects, resulting from an imbalance of NASA's internal project advocacy process and realistic objectives during the budget cycle.

  — Inadequate evaluation of the project's technical complexity and risks leading to either insufficient or inappropriate reserves (fiscal, schedule, and technical).

- Inadequate correlation of mission suitability factors and cost estimates for major system development, leading to submission of unrealistically low initial budgets. This is compounded over time since it encourages industry to submit artificially low cost estimates, resulting in either cost growth or diminished project objectives. When artificially low bids are accepted by NASA and used to rationalize low completion costs and annual funding requirements, project performance can be adversely affected.

- Inadequate tracking of contractor accomplishments against approved plans in a timely fashion, leading to late identification of problems.

3.3 ACQUISITION STRATEGY

NASA fully supports the requirements reiterated by Congress (PL98-369) that emphasize the importance of the competitive process in contract awards. Project Managers serve as the competition advocates when:

- Challenging barriers and promoting full and open competition (F&OC).
- Reviewing project operations and identifying opportunities and actions to achieve F&OC for the project.
- Submitting an annual report and annual F&OC goals and plan for increasing F&OC.

In planning the acquisition strategy, the Project Manager must ensure that adequate time is available to promote F&OC. He must also ensure that specifications or requirements stating the minimum project needs in terms of functional or performance requirements are free of necessary restrictions.

3.3.1 Mission Contracting

The term "mission contracting" refers to the practice of acquiring the complete mission requirements from a single contractor. The mission can be a space flight project or a support service requirement.

In major space flight system requirements, this includes all hardware (space, ground, and launch), software, facilities, and services. The most significant advantages of this acquisition strategy is that the contractor manages the system design, production, and operations trade offs in the most efficient manner and is free to manage the system interfaces to accomplish this purpose. A similar approach may be taken with large interdisciplinary support service requirements.

In either case, the contractor satisfies his obligation under the contract by providing the complete project mission (e.g., characterized by a down link signal) rather than providing the spacecraft, ground equipment, launch vehicle, software, and support of a NASA facility or rather than providing a quantity of labor hours.

3.3.2 Contracting for Phased Projects

Normally, the Phase A Conceptual Studies and Preliminary Analysis are performed by NASA and offer little opportunity for industry participation. The establishment of mission potentials and scientific instruments is accomplished by an AO and a competitive selection of basic research proposals from a general selection and a peer review process.

Agreement on a suitable acquisition plan early in the project planning process is essential for preparing realistic funding and schedule plans. For instance, use of multiple contractors for project definition followed by a competitive development procurement requires an additional period for source selection and may involve an extended Hiatus Period after selection and before New Start Approval is obtained. Use of a single contractor (although selected competitively for project definition studies) who is excluded from the development procurement may limit the design concepts which the project team may consider. The state of technology development may require extensive instrument development, which if not started early, may delay the spacecraft interface requirements definition. The stretch-out of the definition contractors activity at this time may not yield useful project work.

CHAPTER 4

CANDIDATE EVOLUTION AND SELECTION

New project ideas and program needs flow primarily from the efforts expended by the NASA Field Installations on in-house and contracted advanced research and technology studies, from activities of various advisory structures, from the knowledge gained from past and ongoing programs, and from activities performed by various private groups.

Efforts during this Preliminary Analysis Phase are devoted to identifying scientific objectives and/or other mission requirements, technical concepts, and potential flight opportunities with the intent of exposing ideas that could culminate in the development of spaceflight systems. A preliminary scoping of the proposed effort is performed (technical/operational/financial) and may be coordinated with the user and/or scientific community.

As a candidate passes through the various stages toward full-scale development, activities are documented and reviewed on a continual basis. The various documentation requirements and reviews are illustrated in Figure 4-1. The figure entries are explained in the following sections and chapters.

4.1 PROGRAM AGREEMENT

The Program Agreement is a management document that summarizes the PAA's strategic plan for the direction and development of new programs and expansion of existing programs. The Program Agreement is a futuristic planning document not a control document and is separate from the Agency or Federal budget or financial cycles. The document serves as a guide for Field Installations to identify in which areas they desire future participation.

The Program Agreement serves as the agreement between the Administrator and the PAA with input from the Division Directors on the basic objectives, resources, and timing of individual programs, which are identified in the Federal budget. The document is updated to reflect changes in program direction but status data are maintained in the program management processes. The Program Agreement includes, as a minimum:

1. PROGRAM OBJECTIVES—List significant objectives of this program element under the direction of the PAA.

DOCUMENT / ACTIVITY	PROGRAM AGREEMENT	PROJECT STUDY AGREEMENT	PROJECT INITIATION AGREEMENT	PROJECT PLAN	PROJECT APPROVAL DOCUMENT	FINAL REPORTS
CONTRACT BETWEEN	A and PAA	PAA and FID	PAA, FID, and PM	PAA, FID, and PM	A and PAA	
OBJECTIVE	Plan direction and scope of major programs (A strategic plan)	Agree on resource expenditures during Phase B for Candidate Projects	Preliminary management plan for Candidate Projects; A basis for agreement between PAA, FID, and PM	Final management plan for approved Projects	Define agreement between A and PAA on major flight parameters	Enhance performance of future Projects
TIMING	Prior to March POP Review	Prior to commitment of resources by a Field Installation to study a Candidate Project	Early in Definition Phase (B)	After completion of Definition Phase (B)	30 days after Congressional approval	After Project completion
CONTENT	Agreed direction and focus of PAA responsibilities	Same as RTOP but signed by PAA and FID	Same as Project Plan but less detailed	Technical and management plans	Mission parameters, external interfaces, and Agency commitments	Assessment of Project process and relationships
DURATION	Updated annually	Updated annually until Project UPN is established and funded; Provides basis for funding Definition Phase and Hiatus Period	Valid until Project approved for implementation; Superseded by Project Plan.	Agency plan for Project implementation; Updated only for changes in Level I requirements	Life of Project or until changed by Confirmation Review	
REVIEWS	Strategic plan and update review by PAA and Administrator	Definition Reviews and Presentation to PAA for approval to conduct Phase B Studies	Non-Advocate Review and New Start Presentation to Administrator prior to Phases C/D	Confirmation Review approximately 3-6 months after award of implementation contract; Same format as Definition Review; Presentation to PAA; Follows "Understanding Period"	Confirmed annually	Reports to Associate Administrator for Management

Figure 4-1. NASA Program/Project Planning Summary

2. PREVIOUS STUDIES—Describe previous activities and results.

3. RESEARCH/TECHNOLOGY DEVELOPMENT PLAN—Describe structure of activities.

4. IDENTIFICATION OF EXPECTED RESULTS—List direct positive results of the end-product of the research.

The document is written prior to the March POP Review and is updated on an annual basis. It is reviewed initially and annually by the PAA and the Administrator.

4.2 PROJECT STUDY AGREEMENT

The PSA is the agreement between the PAA and the FID on the resources to be applied during the Definition Phase to study a candidate project. It is prepared prior to a commitment of resources by a Field Installation and provides the basis for funding the Definition Phase and the Hiatus Period. This agreement is developed in conjunction with the RTOP process and in RTOP format.

NASA Form 1471 for RTOP (May 1980) can be used to organize the following contents:

1. INVESTIGATION OBJECTIVES—List the major objectives.

2. APPROACH—Describe the investigative tools and methodologies.

3. JUSTIFICATION—Present the motivating reasons for pursuing this investigation at this time.

4. OBJECTIVES AND PLANS—Propose specific plans for accomplishing the major objectives.

5. REPORTING—List the planned distribution of data analysis results, including relevant journal titles and data archival.

6. RESOURCES REQUIREMENTS—Present the following in chart form, categorized by fiscal years:
   a. Human Resources (NASA Direct Civil Service, Other, Contractor Support Workyears)
   b. Total Workyears
   c. R&D Funds (Out-of-House, In-House, Multiprogram Support)
   d. Total R&D Funds
   e. Contracts (Out-of-House, In-House)

The PSA is developed by the FID with input from the user communities and the Headquarters Division Director. It is updated annually until the Unique Project Number (UPN) is established and funded. The PSA is reviewed during the Definition Reviews and presented to the PAA for signature.

4.3 DEFINITION REVIEWS

Reviews of the proposed new project are held on an annual basis. These reviews are organized by the Project Manager for presentation to the PAA. They are conducted during the years that the PAA does not plan to go forward to the Administrator with a New Start request for the project.

The following aspects of a project are reviewed:

- Actual stage of definition of the project in terms of clarity and specificity of objectives.
- Completeness of technical and management specifications and definitions.
- Range of technical, cost, and schedule complexities and associated risks involved.

Definition Reviews serve as a basis for the nonadvocate reviews held prior to the New Start Presentation.

4.4 PROJECT INITIATION AGREEMENT

The PIA serves as the basis for agreement between the PAA, the FID, and the Project Manager to summarize the Agency's preliminary management plan for a proposed project. The PIA is developed early in the Definition Phase and is valid until the project is approved for implementation. The agreement is superseded by the Project Plan when the Plan is approved for the New Start activities.

Obviously, the final details of a project's individual aspects have not been defined at this phase of the project. Proper planning requires that managers should consider the following content areas and define each within the PIA to the fullest extent possible:

1. IDENTIFICATION—Identify the project name, UPN, and anticipated New Start Year.
2. MISSION OBJECTIVES—Briefly state what must be accomplished to meet the primary success requirements of the mission.
3. SOFTWARE—State the software user requirements and the plans for fulfilling those requirements.

4. TECHNICAL CONCEPT—Describe the overall technical aspects of the project system, including space and ground segments.

5. MASTER SCHEDULE—Itemize and depict major events in the implementation stage of the project.

6. MANAGEMENT ORGANIZATION AND RELATIONSHIPS—Overview the management organizational assignments within NASA. Describe the relationships and responsibilities of organizations participating in the project in terms of Section 2.3, "ORGANIZATION RELATIONSHIPS."

7. MANAGEMENT SYSTEMS AND HEADQUARTERS REPORTS—Describe the planned automated information systems and reporting structures.

8. ACQUISITION STRATEGY—List the major systems that need to be acquired and the planned method of acquisition (develop, buy, lease, etc.).

9. RESOURCE ESTIMATES—Present funding and Civil Service Manpower estimates in table form.

10. NEW FACILITIES/CONSTRUCTION IDENTIFICATION—List the facilities that are required to complete the mission, including storage and staging needs of hardware, ground support equipment, and facility support equipment.

11. PERFORMANCE ASSURANCE/SAFETY CONCEPT—Address flight and ground segments for the life cycle of the project, including design, fabrication, integration, test, launch, deployment, and checkout. Describe safety program particulars for the entire mission.

12. RISK ASSESSMENT SUMMARY—Present areas of risk to identify and quantify the probability of problems or hazards. Identify areas of design utilized to eliminate hazards. State the offset of risk in terms other than the application of manpower, schedule, or dollar contingencies.

13. SPECIAL CONSIDERATIONS—Describe those dependent items that might be outside of the Project Manager's control.

14. MAJOR INSTITUTIONAL AGREEMENTS—List all agreements between NASA Field Installations, other government agencies, and, potentially, internationals.

15. PLANNING FOR OPERATIONAL PHASE—Describe the plans for the Operational Phase. Include space and ground system operation; data acquisition, handling, analyses, and distribution; and documentation.

16. SPARES PHILOSOPHY AND PLAN—List what type of spare parts or systems are required, acquisition plan, and storage/replacement plans.

The PIA is used during the nonadvocate review and New Start Presentation to the Administrator prior to approval for the Design and Development Phases.

4.5 NEW START PRESENTATION

A review of the proposed new project is conducted and presented by a nonadvocate team appointed by the PAA before the Agency New Start commitment is requested.

The nonadvocate review team is composed of individuals with expertise in particular relevant fields, yet unassociated with the project in question and without planned participation in project implementation activities. The team leader is appointed by the PAA and is from a NASA component not routinely a part of the project. The leader must have a broad background in space systems program/project management, preferably involving both spacecraft and ground-based systems, and involving both hardware and software development. The Office of the Comptroller at NASA Headquarters provides three team members. Other programs at Headquarters not associated with the project provide as many members as required for proper review. The Program Manager and a representative from the resources group within the Field Installation provide support as required.

4.5.1 Review Team Assessment

The objectives of the nonadvocate review are to assess:

- The actual stage of the definition of the project in terms of clarity and specificity of objectives.
- Completeness of technical and management specifications and definitions.
- Range of technical, cost, and schedule complexities and associated risks involved.

4.5.2 Review Team Comments

The leader of the review team conducts the formal review activities and submits a final report on the project to the PAA. The comments incorporate the findings of the review team to determine the readiness of the project to proceed with the next level of programmatic activities. That, in turn, leads to the New Start Presentation prior to the commitment of the Agency to the implementation of the project.

4.5.3 The Presentation

The PAA presents the technology, cost, and schedule results of the nonadvocate review team to the Administrator and requests his approval to proceed with the Development Phase. This presentation is typically scheduled for July or August, prior to the mid-year POP review, and submission of the NASA budget to the OMB.

4.6 HIATUS PERIOD

There is a period between submission of a New Start request to the OMB and Congressional approval of the budget when project operations are at a low. This generally could be 6 to 18 months; however this may continue into succeeding years until Congressional approval or disapproval of a project. In general, studies are complete at this point but development cannot begin. The Headquarters Division Director and the Program Manager work with the Project Manger to define funding levels and meaningful work activities prior to Congressional approval. The Project Manager is responsible for implementing specific productive activities during this period of time.

CHAPTER 5

FINAL PLANNING AND CONFIRMATION

5.1 DEVELOPING THE PROJECT PLAN

The Project Plan is the statement-of-work agreement/commitment between the Headquarters PAA, the FID, and the Project Manager. The Plan is a detailed description of a project, written during the definition activities. It is approved at the completion of the Definition Phase, reviewed during the Confirmation Review, and updated only for changes in Level 1 requirements.

5.1.1 Objectives

The Project Plan has three main objectives:

- To present the scientific background of the project, including scientific theory. Related programs or projects sponsored by NASA, other government agencies, academia, or private industry may be presented.

- To describe the technical portions of the space and ground systems required to fulfill the scientific requirements and to support the refinement and distribution of data.

- To detail the final management plan, including position descriptions, organizations/review groups, facilities, procurement, resources, schedules, safety, risk assessment, and environmental impact.

5.1.2 Contents

Typical contents of the Project Plan would include, at a minimum:

1. INTRODUCTION—Include the officially approved title, any identification numbers, a general historic background, and mission(s) summary.

2. OBJECTIVES—Narrate the program, project, and mission objectives and the first level of performance requirements.

3. RELATIONSHIP TO OTHER PROGRAMS—Discuss NASA and non-NASA programs and significant studies that have an effect on this project. Appropriate documents are cited, including authors, numbers, dates, and other bibliographic data.

4. TECHNICAL SUMMARY—Give a detailed description of the mission, including hardware, software, flight plans, recovery, and so on. The following subsections are typical but not exhaustive:
   - 4.1 Mission Schedule(s)
   - 4.2 Mission Constraints (physical, time, geographic, planetary)
   - 4.3 Space Segment Systems and Support (summary of each onboard spacecraft system and subsystem)
     - 4.3.1 Spacecraft Structure
     - 4.3.2 Launch Mode and Deployment
     - 4.3.3 Propulsion Systems
     - 4.3.4 Attitude, Guidance, and Stabilization Systems
     - 4.3.5 Communications and Data Handling
     - 4.3.6 Tracking Systems
     - 4.3.7 Thermal/Environmental Systems
     - 4.3.8 Power Systems
   - 4.4 Launch Operations—Arrangements for shuttle launch or alternate launch system, including ESMC or WSMC.
   - 4.5 Ground Segment Systems and Support—An overview of the ground segment and summaries of ground support requirements that vary from project to project.
     - 4.5.1 Mission Analysis
     - 4.5.2 Payload Operations Control Center
     - 4.5.3 Command Memory System
     - 4.5.4 Flight Dynamics and Orbit Maneuver Computations
     - 4.5.5 Attitude Computations
     - 4.5.6 Data Processing System
     - 4.5.7 Data Management Plan
     - 4.5.8 Analysis of Mission Results
     - 4.5.9 Networks
   - 4.6 Technology Plan—The new technology or revisions of existing technology, identifying special areas that require long-range development activities.
   - 4.7 Logistics—All major logistics problems and solutions. Particular attention is paid to special arrangements required between NASA Field Installations.

5. TASK DESCRIPTIONS—Describe the implementation mode of the project, including an overview of the procurement strategy for each major system. Individual work packages or work breakdown structures are also presented.

6. MANAGEMENT PLAN AND ORGANIZATIONAL RELATIONSHIPS—Describe the relationships and responsibilities of key program/project members involved in tasks that cross organizational lines. Include individual position descriptions of key managers at NASA Headquarters and Field Installations. Identify the key management personnel supporting the Project Manager. Include organization charts for NASA Headquarters and the Field Installation.

7. ACQUISITION STRATEGY—Present procurement plans in simple text and chart form. Elements to be included are:
   - 7.1 Elements (e.g., Engineering design study, computer time, space segment, instruments, instrument definition studies, hardware development, alternative systems design concepts, mission and data operations support, ground data handling system, etc.)
   - 7.2 Type of Procurement (Competitive, noncompetitive, AO , transfer of funds to other governmental organizations, combinations)
   - 7.3 Type of Contract (cost-reimbursable, fixed price, incentives)
   - 7.4 Source (Field installation, contractor, university, existing support contractor, other government organizations)
   - 7.5 Technical Monitoring (Title of NASA Field Installation)

8. SCHEDULES—Present Level 2 Milestone Charts and include all major events planned for the entire project, especially external interfaces and major procurement activities.

9. RESOURCES—Present funding and manpower requirements.
   - 9.1 Funding Requirements (including rationale and assumptions used in the development of cost estimates and requirements chart with real-year dollars needed for spacecraft, instruments, ground systems, data reduction and analysis, etc.)
   - 9.2 Manpower Requirements (developed for those projects currently included in manpower Program Operating Plans (POPs)).

10. FACILITIES—Present facilities requirements in chart form, including:
    - 10.1 Function (e.g., Data processing, analysis, and archival; POCC; launch; integration and testing, etc.)
    - 10.2 Facility Required to Support Function

10.3 Location

10.4 Responsible Operating Organization

10.5 Space Required (in square feet)

10.6 Operation Date Required

10.7 Construction or Modification Required

10.8 Estimated Cost

11. SYSTEMS MANAGEMENT—Describe the analysis, development, and implementation plans for all systems software and hardware, including management information, reporting systems, data acquisition and reduction, spacecraft telemetry, etc.

12. MANAGEMENT REVIEWS—Describe the reviews applicable to the project. These might include:

12.1 Systems Concept Review

12.2 Preliminary Design Review

12.3 Critical Design Review

12.4 Pre-environmental Review

12.5 Flight Readiness Review

12.6 Flight Operations Review

12.7 Instrument Reviews

12.8 System Safety

12.9 Mission Operations Planning Review

12.10 Mission and Data Operations Review

12.11 Networks Review

12.12 Space Transportation System (STS) Safety Reviews

12.13 STS Cargo Integration Review

12.14 STS Flight Operations Review

12.15 STS Integrated Hardware/Software Review

12.16 STS Ground Operations Review

12.17 STS Flight Readiness Review

12.18 Management Information System Reporting

12.19 Project Management Reporting

12.20 Contractor Financial Management Reporting

12.21 Contractor Progress Reporting

12.22 Lessons Learned Report

13. HEADQUARTERS CONTROLLED ITEMS—Discuss any items requiring approval of the senior management prior to alteration.

14. PERFORMANCE ASSURANCE AND SAFETY—Outline programs for both space and ground segments, including:
    - 14.1 Reliability
    - 14.2 Quality Assurance
    - 14.3 Parts
    - 14.4 Materials and Processes Control
    - 14.5 Performance Verification
    - 14.6 Review Program
    - 14.7 Industrial Safety
    - 14.8 Range Safety

15. RISK ASSESSMENT—Identify all areas of potential risk. The level of risk (such as low, moderate, high, or some range such as low to moderate) is to be included. A brief description of each risk area also includes the possible consequences of problems or hazards. Identification of design areas utilized to eliminate hazards is included. What is to be accomplished technically to reduce or to eliminate the described areas of concern is also presented.

16. INSTITUTIONAL AGREEMENTS—List each agreement between a Field Installation with other Field Installations, other government agencies, or foreign governments. Copies of the agreements could be included in an appendix.

17. PLANNING FOR THE OPERATIONAL PHASE—Describe plans for project operations, with specific mention made to agreements between the Definition Phase Project Office and an external organization for operational activities.

18. SPARES PHILOSOPHY AND SUPPLY PLAN—Describe project philosophy, procurement strategy, and storage plans for spacecraft and ground hardware spare parts. This may be presented in chart form listed by spare part required.

5.2 PROJECT APPROVAL DOCUMENT

The PAD is the agreement between the Administrator and the PAA on the most significant mission parameters, responsibilities, relationships, resources, and facilities that the Agency is commiting to a pro-

ject. The PAD shall not exceed two pages and a Level 1 master phasing schedule. The contents of a PAD are as follows:

1. PROGRAM—State official title of applicable NASA Budget Program.

2. PROJECT TITLE—Present the officially approved title for the specific project or activity covered by the PAD.

3. OBJECTIVES—Include a statement of the overall objective(s) of the project and the mission success criteria.

4. FUNDING—Include the total R&D and C of F funding by fiscal year and funding from other sources, if any.

5. RESERVES—Discuss the status and confidence level for APA and Contingency reserves.

6. MANPOWER—List Civil Service manpower requirements by fiscal year.

7. AGREEMENTS—List any agreements with supporting Field Installations, other government agencies, and international entities.

8. CONTROLLED ITEMS—List those items requiring approval of the Administrator or PAA prior to alteration.

9. LAUNCH—Identify launch vehicle assigned and projected launch date(s).

10. SCHEDULES—Include the master phasing schedule.

All individual changes to controlled items are incorporated in an annual PAD update to be approved by the Administrator and the PAA.

5.3 UNDERSTANDING PERIOD

After contract award, it is essential that the Project Manager develop control of the detailed, technical content of the selected contractual approach, together with associated costs, before the contract effort reaches full momentum. The early part (3 to 4 months) of a contract period of performance shall be devoted to

developing such control. An assessment as to whether the project needs to be realigned or whether the project content and estimated costs could be achieved must be made. This post-award activity is usually funded at a moderately low level prior to a large-scale commitment of funds. In this early period, the contractor should not benefit from any revision of the project estimate. Further assessments of technical content and compatibility with planned resources must be made periodically as the work progresses.

Following this activity, the Project Manager should reconfirm the earlier cost-to-completion estimate and the commitment by the Project Manager to Headquarters. If the new cost estimate is significantly above the earlier commitment, the Project Manager should indicate any descope options available. The FIDs are responsible for the implementation and monitoring of this reconfirmation activity.

5.4 CONFIRMATION REVIEW

A review of a new project after initiation of the final design and development serves to confirm the schedule and estimated final cost of the project as established in the Project Plan. This review updates the presentation materials used in the Definition Reviews and the New Start Presentation. Changes in technical approach, cost, and schedule are identified from the contractor's proposal and early studies are identified, highlighted, and discussed. In addition, the project provides a risk assessment of the current situation and a plan for attaining the Agency's overall commitment for accomplishing the project. The PAA staffs and conducts the Confirmation Review Team in a manner similar to the Definition Review Team.

5.5 ANNUAL CONFIRMATION REVIEW UPDATE

Each year during the development activities, the project undergoes an update of the Confirmation Review to assess project status. The project gathers input from investigators and contractors to identify major problem areas, track costs, and udpate schedules. The balance of contingency and APA resources are determined. Impacts of schedule delays and requirements changes are determined. Previous review materials are updated and the Confirmation Review Team is reconvened. The results are presented to the PAA for approval of project progress.

CHAPTER 6

MANAGEMENT REPORTING

6.1 PROGRAM OPERATING PLAN

The POP is the official Field Installation submission to the budget system for the R&D and SFCDC appropriations. It is the formal device for updating resource and funding requirements and for comparing progress and status. The POPs are time-phased budgets that are updated twice annually and show detailed five-year forecasts of funding requirements and estimates at completion for each project.

Generally, the POP system provides NASA management with a basis for:

- Preparing Agency estimates during various phases of the budget formulation and execution process.
- Issuing resource authorizations and allotments.
- Evaluating financial performance and status against obligation and cost plans.
- Standardizing the submission of basic financial resource planning data from each Field Installation.

6.1.1 Program Office Review

The Program Office reviews the POPs to ascertain the progress, workload, adherence to schedules, and ability to provide the requested funds to the projects. Each POP is consolidated with the POPs of other Field Installations, which become the Program Office's official budget request to the Agency Administrator.

6.1.2 Agency Administrator Review

The Agency Administrator uses the data contained in the consolidated POPs to:

- Approve budgets of Program Offices for the current year.
- Grant Program Offices the authority for executing their POPs.
- Request funding authority from the OMB.

- Review the budget for the next fiscal year with the OMB.

- Evaluate the performance of the Program Offices by comparing the actual obligations and costs with those stated in the POPs. (Conversely, the Program Offices employ this technique with their Field Installations, and the Field Installations employ it with their Project Managers and procurement staffs.)

6.2 PROGRAM REPORTING REQUIREMENTS

6.2.1 Management Information Systems

Management Information Systems (MISs) for each project are designed to collect, update, store, and disseminate information of business and technical natures. These computerized systems contain global wide and/or local area networks with individual work stations to connect the Project Office with other Field Installation offices, the Headquarters Program Office, and, possibly, experiment investigators at other Field Installations or remote stations. For some projects, the MIS could be configured to include contractor remote facilities. The MIS should be defined early in the development life cycle of the project to keep management at all levels informed on the status of each major action item and decision point of the project.

Access to and use of information available in a computerized MIS must be considered on the basis of current responsibilities and level of detail required to manage the Program Office and Project Office interfaces. As the project scope evolves, the Program and Project Managers must agree on the access, revision, and use of such information.

6.2.2 Reporting to the PAA

One of the primary responsibilities of the project is to report project status, issues, and concerns to management. The frequency and extent of the reporting varies as a function of the phase of the project. In the early phases of the project, the reviews are frequently summaries of the results of the studies performed by Field Installation personnel, contractors, and users. These review meetings identify the technical options and issues in planning the project. As the project progresses through the Definition Phase, the major uncertainties in implementation are resolved. However, major issues related to scientific and technical capabilities and cost and schedule issues associated with trade-offs surface at various reviews. The various reports are summarized in Figure 6-1.

The first level of reporting at NASA Headquarters is to the Division Director. The form and frequency of

reporting varies from Division to Division, and is dependent on the management cycle of the Division Director.

The monthly reporting to the Associate Administrator is more formal and includes set formats for the charts used in the presentations. Examples of these charts may be obtained from the Division Secretary. The Program Manager prepares the charts according to a schedule developed by the Division Director for presentation by the Division Director.

Although the Administrator also has monthly General Management Status Reviews (GMSRs), the project status is not reported at every review. Unless the project and its problems are major, a single GMSR chart to summarize status, issues, and coming events is the only requirement for this event.

Occasions exist when the Associate Administrator and Administrator need an extended briefing on the status of a project. In the absence of a specific request for such a briefing, the Program Manager, in consultation with the Project Manager and Division Director, identifies the need for such a briefing and organizes the meeting. Special events, problems, or program activities may also require immediate informal contact and interaction with upper levels of NASA and industry management.

AS REQUIRED BY DIVISION DIRECTOR	TO: DIVISION DIRECTOR BY: PROGRAM MANAGER FORMAT: VERBAL REPORT AT WEEKLY STAFF MEETING AND/OR ONE PAGE SUMMARY OF STATUS, ISSUES AND CONCERNS
MONTHLY	TO: ASSOCIATE ADMINISTRATOR BY: PROGRAM MANAGER VIA: DIVISION DIRECTOR OR DIVISION DIRECTOR TITLE: PROGRAM REVIEW FORMAT: FOR EACH MAJOR PROJECT, SEVERAL CHARTS INCLUDING • "FEVER CHART" (GREEN IS GOOD, RED IS BAD) • PROGRAM STATUS (INCLUDING FINANCIAL AND MANPOWER) • ISSUES AND CONCERNS (CONCERN/BACKGROUND/ACTION) • FUTURE EVENTS
EVERY FEW MONTHS	TO: ADMINISTRATOR BY: ASSOCIATE ADMINSTRATOR VIA: ASSOCIATE ADMINISTRATOR FROM: DIVISION DIRECTOR FROM: PROGRAM MANAGER TITLE: GENERAL MANAGEMENT AND STATUS REVIEW (GMSR) FORMAT: ONE CHART PER PROJECT SUMMARIZING: • STATUS • PROBLEMS AND CONCERNS • FUTURE EVENTS
IRREGULAR	TO: ADMINISTRATOR OR ASSOCIATE ADMINISTRATOR BY: PROJECT AND PROGRAM MANAGERS PLUS PROJECT TECHNICAL/SCIENCE STAFF TITLE: SPECIAL TECHNICAL SCIENCE OR TECHNICAL STATUS REPORT AND PROBLEM BRIEFINGS FORMAT: UP TO 40 CHARTS AS REQUIRED
ANNUALLY	TO: ASSOCIATE ADMINISTRATOR BY: PROJECT AND PROGRAM MANAGERS AND STAFF TITLE: ANNUAL CONFIRMATION REVIEW UPDATE FORMAT: UPDATE OF CHARTS USED IN CONFIRMATION REVIEW

Figure 6-1. Reporting to Program Associate Administrator

CHAPTER 7

FINAL ASSESSMENT ACTIVITIES

Final assessment activities are performed for project management personnel to share triumphs as well as the areas that need improvement. These activities should occur within 3 to 6 months of launch or immediately following a short-term mission.

7.1 INDUSTRY ASSESSMENT REPORT

The Industry Assessment Report is developed by the major contractors to describe—in an independent mode—the major management problems encountered during the project. This report is a narrative to provide the AA for Management with an independent assessment of the project. The goal of the report is toward the improvement of government/private industry relations on future projects of a similar scope. The contents should include the following:

- The three most challenging management problems encountered during the project.
- The resolutions employed.
- Successful risk identification, management, and resolution.
- Realism of schedules, funding, and manpower resources estimates.
- Procurement approaches.
- Organizational relationships as they affected project performance.
- Recommendations for future projects encountering similar situations.

7.2 LESSONS LEARNED REPORT

The Lessons Learned Report is developed by the FID in cooperation with the Project Manager. This report is a narrative to provide the AA for Management with the Field Installation assessment of the management of the project. The goal of the report is toward the improvement of government/private industry relations on

future projects of a similar scope. The contents should include the following:

- The three most challenging management problems encountered during the project.
- The resolutions employed.
- Successful risk identification, management, and resolution.
- Realism of schedules, funding, and manpower resources estimates.
- Procurement approaches.
- Organizational relationships as they affected project performance.
- Recommendations for future projects encountering similar situations.

7.3 IMPLEMENTATION OF PROJECT AND INDUSTRY ASSESSMENTS

The Lessons Learned Report and the Industry Assessment Report are submitted independently to the Associate Administrator for Management to review. Following his review of the project management, he makes recommendations to all PAAs regarding the conduct of future projects.